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COMPARATIVE EVALUATION OF TWO TYPES OF ELECTRICALLY HEATED WIND--ETC(U)
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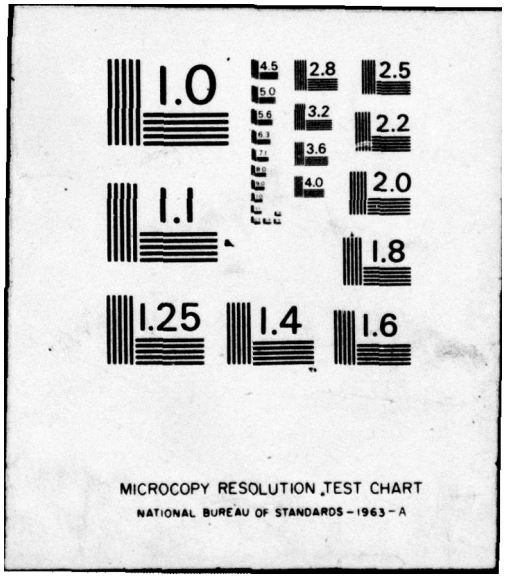
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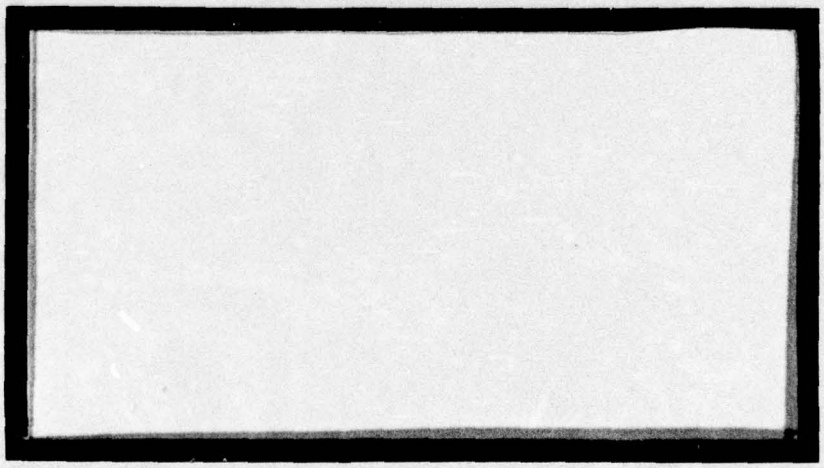

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US ARMY

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FORT RUCKER, ALABAMA

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(9) Final ≠ rept.

REPORT OF TEST

USATECOM PROJECT NUMBERS 4-3-5200-01-D AND 4-3-5200-02-D

(6) COMPARATIVE EVALUATION OF TWO TYPES OF ELECTRICALLY HEATED WINDSHIELDS INSTALLED ON A CV-2A AIRPLANE

(11) 30 Sep 63

30 SEP 1963

(12) 14 p.

FOR OFFICIAL USE ONLY

UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama

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PART I - GENERAL

A. REFERENCES. A list of references is contained in part III.

B. AUTHORITY.

1. Directive. USATECOM Message 19349, 051800Z December 1962.

2. Purpose. To determine the relative suitability of an electrically heated, laminated, glass windshield and an electrically heated, laminated, plastic windshield for use on a CV-2A Airplane.

C. BACKGROUND.

1. DeHavilland Aircraft of Canada, Ltd., manufacturers of the CV-2( ) Airplane, submitted on 27 April 1962 an Engineering Change Proposal (ECP AC-1-90) to introduce heated windshields having outer laminates of glass to replace existing heated windshields, having outer laminates of plastic. The following reasons for changes were given:

a. To provide an improved product at a lower cost.

b. To reduce the current rate of windshield rejection due to optical deficiencies.

c. To reduce unserviceability due to delamination.

d. To increase resistance to abrasion during windshield wiper operation.

2. The ECP, which was subsequently approved, proposed to install eight sets of glass windshields in US Army CV-2( ) Airplanes prior to delivery in order to obtain service test data and experience. The cost proposal quoted a production-line decrease of $1,958, in Canadian funds, per airplane. Modification kits for the inverters would be necessary to provide increased electrical power. A weight increase of 15.6 pounds per airplane would be incurred.

3. The US Army Aviation Test Board concurred with the ECP for the installation of eight windshields for test purposes on the basis of several Unsatisfactory Reports (UR's) having been forwarded against the plastic windshield.

4. Representatives of the manufacturer of the plastic windshield stated that delamination (separation and discoloration of the laminations) reported in the UR's had been eliminated by quality control during manufacture, installation, and maintenance of the windshields. By use of mercury element temperature control, the initial cost could be substantially reduced.

5. Message, TCMAC-QIAC-1-05-01537, (reference 2) requested procurement and testing of glass windshields by the US Army Transportation Aircraft Test and Support Activity (USATATSA).

6. Two sets of glass windshields were ordered on 11 June 1962, and one set was delivered in December 1962. In November 1962, the US Army Test and Evaluation Command (USATECOM) requested an evaluation and logistical test be performed on the glass windshields as suitable replacements for the plastic windshields (reference 3).

7. In December 1962, USATECOM directed by message (reference 1) that a comparative evaluation of the two types of windshields be made prior to 31 December 1962. The USAAVNTBD acknowledged the directive and explained circumstances which made the 31 December 1962 deadline impossible (reference 4). An evaluation of the windshields would be completed not later than March 1963, the six-month logistical evaluation would be completed by July 1963, and the report of test would be forwarded in the first quarter FY 64.

D. DESCRIPTION OF MATERIEL.

1. The plastic windshield consists of a wire heating element sandwiched between plastic laminates coated with a clear conductor.

The heating element receives its electrical input from a separate inverter for each windshield half. The warmed windshield provides increased "bird-proofing" as well as anti-icing. A control on the instrument panel selects ON, OFF, or EMERGENCY. In the event the pilot windshield element fails, power for the copilot element may be transferred to the pilot side by switching to EMERGENCY. The test windshield provided improved temperature control by means of a mecury sensory element and controller-adapter. The windshield is tinted a light-brown color. The installed weight is 23.4 pounds.

2. The construction of the glass windshield is generally similar to that of the plastic windshield except that its laminates are of shatterproof glass with a stannous-oxide coating as a conductor. The warmed glass windshield also provides increased "bird-proofing" as well as anti-icing. An inverter modification kit for the glass windshield was required for the test installation to supply the increased voltage needed. The windshield is clear in color. The installed weight is 39 pounds.

E. TEST OBJECTIVES. To determine by evaluating both glass and plastic windshields during day and night and in inclement weather during a period of six months:

1. Presence of distortion.

2. Effect of windshield wiper operation.

3. Interference with the airplane's communication system.

4. Suitability for night and instrument operation.

5. Anti-icing and de-icing capabilities.

6. Maintenance requirements.

F. FINDINGS.

1. The distortion present in the installed glass windshield was objectionable during taxiing and parking but was not distracting in flight because the vision of the pilot was not directed to a point near the airplane. There was no objectionable distortion present in the plastic windshields.

2. The glass windshield was not adversely affected by wiper operation; however, the plastic windshield became so scratched by the end of test that visibility was intolerably impaired.

3. Both types of windshield caused objectionable noise in the test airplane's communication system.

4. Both types of windshield were suitable for night and instrument operation. Under these conditions, the untinted glass windshield afforded considerably more visibility.

5. Both types of windshield satisfactorily prevented the formation of frost and ice. After ice had accumulated, the plastic windshield removed it faster and more efficiently than the glass windshield.

6. No maintenance was required for either windshield except for an unsuccessful attempt to remove scratches from the plastic windshield.

G. CONCLUSIONS.

1. Both the glass and the plastic windshields are satisfactory with respect to anti-icing and de-icing capabilities.

2. The glass windshield is more suitable than the plastic windshield with respect to operational and maintenance suitability.

3. Both windshields are unsuitable with respect to electronic interference.

H. RECOMMENDATION. It is recommended that the glass windshield be procured for use on all CV-2( ) Airplanes and the electronic interference eliminated.

A. J. RANKIN
Colonel, Armor
President

PART II - TEST DATA

A. SCOPE. A YCV-2A Airplane, serial number 57-3083, with a heated, laminated, glass windshield panel installed in the right half (copilot's side) of the windshield, and a heated, laminated, plastic windshield panel installed in the left half (pilot's side) of the windshield was flown during the period 26 January 1963 - 26 July 1963. During the operational and logistical evaluation, 203 hours and 35 minutes were flown under various operational and climatic conditions. In addition, flights were made in a water spray delivered by a tanker airplane at freezing temperatures to determine each windshield's anti-icing and de-icing capability. Comments regarding operational experience with the windshields were solicited from other using agencies (references 7, 8, 9, and 10).

B. TESTS.

1. Operational Suitability. During this test, qualified pilots and observers evaluated the operational suitability of both windshield types in flight and on the ground. Flights were made by day and night and in weather, with windshield wipers in operation during precipitation (3 hours and 50 minutes total). Flights were made in a water spray provided by a C-130 tanker airplane in conditions suitable for testing anti-icing and de-icing capabilities of the windshields. The following was determined:

a. General.

(1) Some distortion was found in individual glass windshield halves. Of the windshield installation in seven airplanes examined (14 halves), three windshield halves contained noticeable distortion areas in the line of sight from the pilot to the ground in front of the airplane and in level line at the 10 o'clock position (or 2 o'clock position, depending upon which half). The distortion areas present in the test airplane were objectionable during taxiing and parking operations but were not distracting to the pilot in flight. There was no objectionable distortion present in the plastic windshields. A narrow line of distortion prevailed along the edges of the windshield panel; however, this was not distracting to the pilot. The glass windshields being installed in current production airplanes were inspected at the manufacturer's installation, and these windshields had no discernible distortion areas.

(2) The windshield wipers on the test airplane were operated coincidently with the encounter of precipitation. Scratches on the plastic windshield surface occurred after the first one-hour operation of the windshield wiper. Attempts to remove the scratches by polishing were unsuccessful. The amount of scratching increased so that by the end of the test period, visibility was intolerably impaired. The glass windshield was not adversely affected by windshield wiper operation. (A letter received from the Army Concept Team in Vietnam (reference 10) reported that scratches occurring on the surfaces of plastic windshields in CV-2B airplanes operating in the environment of the Republic of Vietnam had become a major problem.)

(3) Electronic interference from both windshield types caused noise in the test airplane intercommunications system to an objectionable degree. A comparison of electronic interference noise was made by a representative from the Electronics Materiel Agency, Fort Monmouth, N. J., and it was determined that the glass windshield created less noise than the plastic windshield; however, the noise from either windshield was distracting to the crew and, in the opinion of qualified medical officers, would be harmful to the ear over an extended period of time.. Radio communications were not noticeably affected by the electronic interference. A practical solution to the problem could not be envisioned by electronics engineers from the US Army Signal Research and Development Laboratories, Fort Monmouth, N. J.

b. Day Operation. The brown-tinted plastic windshield was advantageous in reducing glare from the sun as compared with the clear glass windshield.

c. Night Operation. Both windshield types were suitable for night operation. Visibility through the glass windshield was slightly superior to that of the brown-tinted plastic windshield.

d. Instrument Operation. The two windshield types were suitable for instrument operation. The untinted glass windshield provided slightly superior visibility during low-visibility approaches in weather.

e. Anti-Frosting and Anti-Icing Operation. Both windshield types performed equally satisfactorily in preventing the formation of frost and ice; however, the plastic windshield removed accumulated ice faster and more completely. Two flights totaling 2 hours and

40 minutes were conducted behind an Air Force C-130 tanker airplane which delivered a water spray at freezing temperature. With the windshield heat turned on prior to entering the freezing spray, ice failed to form on any part of the plastic windshield surface. Ice accumulated around the edges of the glass windshield surface, although visibility was unimpaired. During this time, more than 1/2 inch of ice accumulated on the unprotected airframe. The heat was then turned off and the ice was allowed to build on the windshield for one minute and the heat then turned on. The plastic windshield panel was completely clean in 1 1/2 minutes with the exception of small patches of ice in the upper left corner and lower center. The glass windshield panel, after 1 1/2 minutes of heat application, melted a hole in the ice approximately 2 inches in diameter at the center of the panel. The windshield wiper was then used to remove all but approximately 30 percent of the accumulated ice. Visibility forward was adequate for safe flight.

f. Operation Manuals. No changes in the Operations Manual (TM 55-1510-206-10) would be required as a result of installation of the plastic windshield. If the glass windshields were installed, a change in description of the windshield (Chapter 6, paragraph 5-4) would be necessary.

2. Logistical Suitability. A logistical evaluation of the windshields was conducted and the following information obtained.

a. A total of 118.5 man-hours was expended on the installation of the test windshield panels. This figure includes preparation of the airplane, removal of the old standard windshield, the modification of the electrical system for the windshield panels, and the installation of both the glass and plastic windshield panels.

b. No special tools or equipment were required for the test windshield installation.

c. No maintenance was required for the test windshield installation other than an unsuccessful attempt to remove the scratches (see paragraph B1b) which required approximately 0.5 man-hour.

d. Windshield maintenance information contained in TM 55-1510-206-20, dated August 1962, and TM 55-1510-206-34, dated June 1962, is applicable to the original plastic windshields installed

in CV-2( ) airplanes. If the test plastic windshield is selected as a replacement item, applicable portions of the instructions will require updating to include changes to the electrical system. If the glass windshield is selected as a replacement item, all windshield maintenance information will require a major rewrite.

e. One Equipment Improvement Recommendation was submitted against the scratched plastic windshield during the test program by the USAAVNTBD.

PART III - LIST OF REFERENCES

1. USATECOM Message 19349, 051800Z, December 1962.

2. Message, TCMAC-QIAC-1-05-01537, 15 May 1962.

3. Message, SMOSM, ECV-2(AC-1)-11-1365, 21 November 1962.

4. Message, STEBG-AAAB 12-1, US Army Aviation Board, 4 December 1962.

5. Telecon, Mr. Richard Trumper, Electronics Materiel Agency, Fort Monmouth, New Jersey, 24 April 1963.

6. US Air Force, Aeronautical Systems Division, Wright-Patterson AFB, Ohio, Report of Test, subject: "Caribou Windshield Anti-Icing Test," 11 February 1963.

7. Letter, 61st Aviation Company (FWLT), Fort Bragg, North Carolina, 22 December 1962, subject: "Glass Laminate Windshields Installed in Aircraft S/N 61-2405."

8. Letter, Headquarters, US Army Transportation School, Fort Eustis, Virginia, 21 January 1963, subject: "Windshield Installation in CV-2 Aircraft S/N 61-2595."

9. Letter, Headquarters, US Army Aviation School, Fort Rucker, Alabama, 13 February 1963, subject: "Windshield Installation in CV-2 Aircraft S/N 61-2591."

10. Letter, Army Concept Team in Vietnam, 11 June 1963, subject: "Investigation of CV-2B Windshield Problems."

AD_____Accession No._____
US Army Aviation Test Board, Fort Rucker, Alabama
Comparative Evaluation of Two Types of Electrically Heated Windshields Installed on a CV-2A Airplane. Final Report, ETA 20 Sep 1963. USATECOM Project Numbers 4-3-5200-01-D and 4-3-5200-02-D, 18 pp. For Official Use Only.
Electrically heated, laminated glass and plastic windshields were evaluated to determine their suitability for use on CV-2A Airplanes. It was concluded that both glass and plastic windshields are satisfactory with respect to anti- and de-icing capabilities; however, the glass windshield is more suitable with respect to operational and maintenance suitability. Both windshields are unsuitable with respect to electronic interference. It was recommended that the glass windshield be procured for use on all CV-2( ) Airplanes and the electronic interference be eliminated.

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